

## **APPENDIX C: “None/Some/Good Table”**

# **Response of Radiation Monitoring Instruments to Normalized Risk Quantities of Radionuclides**

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**Part III**  
**Department of Transportation**  
**Research and Special Programs Administration**  
**49 CFR Part 171, et al.**  
**Hazardous Materials, Transportation Regulations;**  
**Compatibility with Regulation of the International Atomic Energy**  
**Agency;**  
**Final Rule**  
**September 28, 1995**

**Appendix C: “None/Some/Good” Table**

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M = minute    D = day  
H = hour      Y = year

G = good  
S = some      N = none

Response of Radiation Monitoring Instruments to Normalized Risk Quantities of Radionuclides					
			700 Shield		715
Nuclide	Half-life	Radiation	Open	Closed	
<i>Actinium</i>					
Ac-225	10.0 D	$\alpha\beta\gamma$	G	S	N
Ac-227	21.773 Y	$\alpha\beta\gamma$	N	N	N
Ac-228	6.13 H	$\beta\gamma$	G	G	S
<i>Aluminum</i>					
Al-26	7.16E5 Y	$\beta\gamma$	G	G	G
<i>Americium</i>					
Am-241	432.2 Y	$\alpha\beta\gamma$	N	N	N
Am-242m	152 Y	$\alpha\beta\gamma$	G	N	N
Am-243	7380 Y	$\alpha\beta\gamma$	G	N	N
<i>Antimony</i>					
Sb-122	2.70 D	$\beta\gamma$	G	G	S
Sb-124	60.20 D	$\beta\gamma$	G	G	G
Sb-125	2.77 Y	$\beta\gamma$	G	G	S
Sb-126	12.4 D	$\beta\gamma$	G	G	S
<i>Argon</i>					
Ar-37	35.02 D	$\beta\gamma$	N	N	N
Ar-39	269 Y	$\beta$	G	N	N
Ar-41	1.827 H	$\beta\gamma$	G	G	S
<i>Arsenic</i>					
As-72	26.0 H	$\beta\gamma$	G	G	S
As-73	80.30 D	$\beta\gamma$	G	G	G
As-74	17.76 D	$\beta\gamma$	G	G	S
As-76	26.32 H	$\beta\gamma$	G	G	N
As-77	38.8 H	$\beta\gamma$	G	S	N
<i>Astatine</i>					
At-211	7.214 H	$\alpha\beta\gamma$	G	G	S
<i>Barium</i>					
Ba-131	11.8 D	$\beta\gamma$	G	G	G
Ba-133	10.74 Y	$\beta\gamma$	G	G	G
Ba-133m	38.9 H	$\beta\gamma$	G	G	N
Ba-140	12.74 D	$\beta\gamma$	G	G	S

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Berkelium</i>					
Bk-247	1380 Y	$\alpha\beta\gamma$	N	N	N
Bk-249	320 D	$\alpha\beta\gamma$	N	N	N
<i>Beryllium</i>					
Be-7	53.3 D	$\beta\gamma$	G	G	G
Be-10	1.6E6 Y	$\beta$	G	N	N
<i>Bismuth</i>					
Bi-205	15.31 D	$\beta\gamma$	G	G	S
Bi-206	6.243 D	$\beta\gamma$	G	G	G
Bi-207	38 Y	$\beta\gamma$	G	G	G
Bi-210	5.012 D	$\beta\gamma$	G	N	N
Bi-210m	3.0E6 Y	$\alpha\beta\gamma$	G	G	N
Bi-212	60.55 M	$\alpha\beta\gamma$	G	G	N
<i>Bromine</i>					
Br-76	16.2 H	$\beta\gamma$	G	G	S
Br-77	56 H	$\beta\gamma$	G	G	G
Br-82	35.30 H	$\beta\gamma$	G	G	S
<i>Cadmium</i>					
Cd-109	464 D	$\beta\gamma$	G	G	S
Cd-113M	13.6 Y	$\beta$	G	N	N
Cd-115	53.46 H	$\beta\gamma$	G	G	S
Cd-115m	44.6 D	$\beta\gamma$	G	S	N
<i>Calcium</i>					
Ca-41	1.4E5 Y	$\beta\gamma$	N	N	N
Ca-45	163 D	$\beta\gamma$	G	N	N
Ca-47	4.53 D	$\beta\gamma$	G	G	S
<i>Californium</i>					
Cf-248	333.5 D	$\alpha\beta\gamma$	N	N	N
Cf-249	350.6 Y	$\alpha\beta\gamma$	N	N	N
Cf-251	13.08 Y	$\alpha\beta\gamma$	N	N	N
Cf-252	898 Y	$\alpha\beta\gamma$	N	N	N
Cf-253	17.81 Y	$\alpha\beta\gamma$	G	N	N
Cf-254	60.5 D	$\alpha\beta\gamma$	S	S	N
<i>Carbon</i>					
C-11	20.38 M	$\beta\gamma$	G	S	N
C-14	5730 Y	$\beta\gamma$	N	N	N

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Cerium</i>					
Ce-139	137.66 D	$\beta\gamma$	G	G	G
Ce-141	32.501 D	$\beta\gamma$	G	G	N
Ce-143	33.0 H	$\beta\gamma$	G	G	S
Ce-144	284.3 D	$\beta\gamma$	G	G	N
<i>Cesium</i>					
Cs-129	32.06 H	$\beta\gamma$	G	G	G
Cs-131	9.69 D	$\beta\gamma$	G	G	G
Cs-132	6.475 D	$\beta\gamma$	G	G	G
Cs-134	2.062 Y	$\beta\gamma$	G	G	G
Cs-134m	2.90 H	$\beta\gamma$	G	G	S
Cs-135	2.3E6 Y	$\beta$	G	N	N
Cs-136	13.1 D	$\beta\gamma$	G	G	S
Cs-137	30.0 Y	$\beta\gamma$	G	G	S
<i>Chlorine</i>					
Cl-36	3.01E5 Y	$\beta\gamma$	G	N	N
Cl-38	37.21 M	$\beta\gamma$	G	G	N
<i>Chromium</i>					
Cr-51	27.704 D	$\beta\gamma$	G	G	G
<i>Cobalt</i>					
Co-56	78.76 D	$\beta\gamma$	G	G	G
Co-57	270.9 D	$\beta\gamma$	G	G	G
Co-58	70.80 D	$\beta\gamma$	G	G	G
Co-58m	9.15 H	$\beta\gamma$	S	N	N
Co-60	5.271 Y	$\beta\gamma$	G	G	G
<i>Copper</i>					
Cu-64	12.701 H	$\beta\gamma$	G	G	G
Cu-67	61.86 H	$\beta\gamma$	G	G	S
<i>Curium</i>					
Cm-240	27 D	$\alpha\beta\gamma$	N	N	N
Cm-241	32.8 D	$\alpha\beta\gamma$	G	G	G
Cm-242	162.8 D	$\alpha\beta\gamma$	N	N	N
Cm-243	28.5 Y	$\alpha\beta\gamma$	N	N	N
Cm-244	18.11 Y	$\alpha\beta\gamma$	N	N	N
Cm-245	8500 Y	$\alpha\beta\gamma$	N	N	N
Cm-246	4730 Y	$\alpha\beta\gamma$	N	N	N
Cm-247	1.56E7 Y	$\alpha\beta\gamma$	G	N	N
Cm-248	3.39E5 Y	$\alpha\beta\gamma$	N	N	N

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Dysprosium</i>					
Dy-159	144.4 D	$\beta\gamma$	G	G	G
Dy-165	2.334 H	$\beta\gamma$	G	S	N
Dy-166	81.6 H	$\beta\gamma$	G	G	N
<i>Erbium</i>					
Er-169	9.3 D	$\beta\gamma$	G	N	N
Er-171	7.52 H	$\beta\gamma$	G	G	S
<i>Europium</i>					
Eu-147	24 D	$\alpha\beta\gamma$	G	G	G
Eu-148	5.5 D	$\alpha\beta\gamma$	G	G	G
Eu-149	93.1 D	$\beta\gamma$	G	G	G
Eu-152	13.33 Y	$\beta\gamma$	G	G	G
Eu-152m	9.32 H	$\beta\gamma$	G	G	G
Eu-154	8.8 Y	$\beta\gamma$	G	G	S
Eu-155	4.96 Y	$\beta\gamma$	G	G	S
Eu-156	15.19 D	$\beta\gamma$	G	G	S
<i>Fluorine</i>					
F-18	107.77 M	$\beta\gamma$	G	G	S
<i>Gadolinium</i>					
Gd-146	48.3 D	$\beta\gamma$	G	G	G
Gd-153	242 D	$\beta\gamma$	G	G	G
Gd-159	18.56 H	$\beta\gamma$	G	G	N
<i>Gallium</i>					
Ga-67	78.26 H	$\beta\gamma$	G	G	G
Ga-68	68.0 M	$\beta\gamma$	G	G	N
Ga-72	14.1 H	$\beta\gamma$	G	G	G
<i>Germanium</i>					
Ge-68	288 D	$\beta\gamma$	G	G	S
Ge-71	11.8 D	$\beta\gamma$	G	N	S
Ge-77	11.30 H	$\beta\gamma$	G	G	S
<i>Gold</i>					
Au-193	17.65 H	$\beta\gamma$	G	G	G
Au-194	39.5 H	$\beta\gamma$	G	G	G
Au-195	183 D	$\beta\gamma$	G	G	G
Au-198	2.696 D	$\beta\gamma$	G	G	S
Au-199	3.139 D	$\beta\gamma$	G	G	S

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			<b>Open</b>	<b>Closed</b>	
<i>Hafnium</i>					
Hf-172	1.87 Y	$\beta\gamma$	G	G	S
Hf-175	70 D	$\beta\gamma$	G	G	G
Hf-181	42.4 D	$\beta\gamma$	G	G	S
Hf-182	9E6 Y	$\beta\gamma$	G	G	N
<i>Holmium</i>					
Ho-166	26.80 H	$\beta\gamma$	G	S	N
Ho-166m	1.20E3 Y	$\beta\gamma$	G	G	S
<i>Hydrogen</i>					
H-3	12.35 Y	$\beta$	N	N	N
<i>Indium</i>					
In-111	2.83 D	$\beta\gamma$	G	G	G
In-113m	1.658 H	$\beta\gamma$	G	G	S
In-114m	49.51 D	$\beta\gamma$	G	G	N
In-115m	4.486 H	$\beta\gamma$	G	G	S
<i>Iodine</i>					
I-123	13.2 H	$\beta\gamma$	G	G	G
I-124	4.18 D	$\beta\gamma$	G	G	G
I-125	60.14 D	$\beta\gamma$	G	S	S
I-126	13.0 D	$\beta\gamma$	G	G	S
I-129	1.57E7 Y	$\beta\gamma$	G	G	G
I-131	8.04 D	$\beta\gamma$	G	G	S
I-132	2.30 H	$\beta\gamma$	G	G	S
I-133	20.8 H	$\beta\gamma$	G	G	S
I-134	52.6 M	$\beta\gamma$	G	G	S
I-135	6.61 H	$\beta\gamma$	G	G	S
<i>Iridium</i>					
Ir-189	13.3 D	$\beta\gamma$	G	G	G
Ir-190	12.1 D	$\beta\gamma$	G	G	S
Ir-192	74.02 D	$\beta\gamma$	G	G	S
Ir-194	19.15 H	$\beta\gamma$	G	G	N
<i>Iron</i>					
Fe-52	8.275 H	$\beta\gamma$	G	G	S
Fe-55	2.7 Y	$\beta\gamma$	N	N	N
Fe-59	44.529 D	$\beta\gamma$	G	G	G
Fe-60	1E5 Y	$\beta\gamma$	G	S	N

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			<b>Open</b>	<b>Closed</b>	
<i>Krypton</i>					
Kr-81	2.1E5 Y	$\beta\gamma$	G	G	G
Kr-85	10.72 Y	$\beta\gamma$	G	G	N
Kr-85m	4.48 H	$\beta\gamma$	G	G	G
Kr-87	76.3 M	$\beta\gamma$	G	G	N
<i>Lanthanum</i>					
La-137	6E4 Y	$\beta\gamma$	G	S	S
La-140	40.272 H	$\beta\gamma$	G	G	S
<i>Lead</i>					
Pb-201	9.4 H	$\beta\gamma$	G	G	G
Pb-202	3E5 Y	$\beta\gamma$	G	G	G
Pb-203	52.05 H	$\beta\gamma$	G	G	G
PB-205	1.43E7 Y	$\beta\gamma$	G	N	S
Pb-210	22.3 Y	$\alpha\beta\gamma$	G	N	N
Pb-212	1064 H	$\alpha\beta\gamma$	G	G	S
<i>Lutetium</i>					
Lu-172	6.70 D	$\beta\gamma$	G	G	G
Lu-173	1.37 Y	$\beta\gamma$	G	G	G
Lu-174	3.31 Y	$\beta\gamma$	G	G	S
Lu-174m	142 D	$\beta\gamma$	G	G	G
Lu-177	6.71 D	$\beta\gamma$	G	G	N
<i>Magnesium</i>					
Mg-28	20.91	$\beta\gamma$	G	G	S
<i>Manganese</i>					
Mn-52	5.591 D	$\beta\gamma$	G	G	G
Mn-53	3.7E6 Y	$\beta\gamma$	N	N	N
Mn-54	312.5 D	$\beta\gamma$	G	G	G
Mn-56	2.5785 H	$\beta\gamma$	G	G	S
<i>Mercury</i>					
Hg-194	260 Y	$\beta\gamma$	G	G	G
Hg-195m	41.6 H	$\beta\gamma$	G	G	G
Hg-197	64.1 H	$\beta\gamma$	G	G	G
Hg-197m	23.8 H	$\beta\gamma$	G	G	S
Hg-203	46.60 D	$\beta\gamma$	G	G	S
<i>Mixed Fission Products</i>					
MFP		$\beta\gamma$	G	G	S

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			<b>Open</b>	<b>Closed</b>	
<i>Molybdenum</i>					
Mo-93	3.5E3 Y	$\beta\gamma$	G	N	G
Mo-99	66.0 H	$\beta\gamma$	G	G	S
<i>Neodymium</i>					
Nd-147	10.98 D	$\beta\gamma$	G	G	N
Nd-149	1.73 H	$\beta\gamma$	G	G	N
<i>Neptunium</i>					
Np-235	396.1 D	$\alpha\beta\gamma$	G	G	G
Np-237	2.14E6 Y	$\alpha\beta\gamma$	N	N	N
Np-239	2.355 D	$\beta\gamma$	G	G	S
<i>Nickel</i>					
Ni-59	7.5E4 Y	$\beta\gamma$	N	N	N
Ni-63	96 Y	$\beta$	N	N	N
Ni-65	2.520 H	$\beta\gamma$	G	G	N
<i>Niobium</i>					
Nb-93m	13.6 Y	$\beta\gamma$	G	N	S
Nb-94	2.03E4 Y	$\beta\gamma$	G	G	G
Nb-95	35.15 D	$\beta\gamma$	G	G	S
Nb-97	72.1 M	$\beta\gamma$	G	G	N
<i>Nitrogen</i>					
N-13	9.965 M	$\beta\gamma$	N	N	N
<i>Osmium</i>					
Os-185	94 D	$\beta\gamma$	G	G	G
Os-191	15.4 D	$\beta\gamma$	G	G	S
Os-191m	13.03 H	$\beta\gamma$	G	G	G
Os-193	30.0 H	$\beta\gamma$	G	G	N
Os-194	6.0 Y	$\beta\gamma$	G	G	N
<i>Palladium</i>					
Pd-103	16.96 D	$\beta\gamma$	G	G	G
Pd-107	65E6 Y	$\beta$	N	N	N
Pd-109	13.427 H	$\beta\gamma$	G	S	N
<i>Phosphorus</i>					
P-32	14.29 D	$\beta$	G	N	N
P-33	25.4 D	$\beta$	G	N	N

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Platinum</i>					
Pt-188	10.2 D	$\beta\gamma$	G	G	S
Pt-191	2.8 D	$\beta\gamma$	G	G	G
Pt-193	50 Y	$\beta\gamma$	G	N	G
Pt-195m	4.02 D	$\beta\gamma$	G	G	S
Pt-197	18.3 H	$\beta\gamma$	G	G	N
Pt-197m	94.4 M	$\beta\gamma$	G	G	N
<i>Plutonium</i>					
Pu-236	2.81 Y	$\alpha\beta\gamma$	N	N	N
Pu-237	45.3 D	$\alpha\beta\gamma$	G	G	G
Pu-238	87.74 Y	$\alpha\beta\gamma$	N	N	N
Pu-239	24065 Y	$\alpha\beta\gamma$	N	N	N
Pu-240	6537 Y	$\alpha\beta\gamma$	N	N	N
Pu-241	14.4 Y	$\alpha\beta\gamma$	N	N	N
Pu-242	3.76E5 Y	$\alpha\beta\gamma$	N	N	N
Pu-244	8.26E7 Y	$\alpha\beta\gamma$	G	N	N
<i>Polonium</i>					
Po-210	1.38.38 D	$\alpha\beta\gamma$	N	N	N
<i>Potassium</i>					
K-42	12.36 H	$\beta\gamma$	G	G	N
K-43	22.6 H	$\beta\gamma$	G	G	S
<i>Praseodymium</i>					
Pr-142	19.13 H	$\beta\gamma$	G	G	N
Pr-143	13.56 D	$\beta\gamma$	G	N	N
<i>Promethium</i>					
Pm-143	265 D	$\beta\gamma$	G	G	G
Pm-144	363 D	$\beta\gamma$	G	G	G
Pm-145	17.7 Y	$\beta\gamma$	G	G	S
Pm-147	2.6234 Y	$\beta\gamma$	G	N	N
Pm-148m	41.3 D	$\beta\gamma$	G	G	G
Pm-149	53.08 H	$\beta\gamma$	G	S	N
Pm-151	28.40 H	$\beta\gamma$	G	G	S
<i>Protactinium</i>					
Pa-230	17.4 D	$\alpha\beta\gamma$	G	G	S
Pa-231	3.276E4 Y	$\alpha\beta\gamma$	N	N	N
Pa-233	27.0 Y	$\beta\gamma$	G	G	S

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			<b>Open</b>	<b>Closed</b>	
<i>Radium</i>					
Ra-223	11.434 D	$\alpha\beta\gamma$	G	S	N
Ra-224	3.66 D	$\alpha\beta\gamma$	G	G	N
Ra-225	14.8 D	$\alpha\beta\gamma$	G	S	N
Ra-226	1600 Y	$\alpha\beta\gamma$	G	G	N
Ra-228	5.75 Y	$\beta\gamma$	G	G	N
<i>Radon</i>					
Rn-222	3.8235 D	$\alpha\beta\gamma$	G	S	N
<i>Rhenium</i>					
Re-184	38.0 D	$\beta\gamma$	G	G	G
Re-184m	165 D	$\beta\gamma$	G	G	G
Re-186	90.64 H	$\beta\gamma$	G	G	N
Re-187	5E10 Y	$\beta$	N	N	N
Re-188	16.98 Y	$\beta\gamma$	G	G	N
Re-189	24.3 H	$\beta\gamma$	G	G	N
<i>Rhodium</i>					
Rh-99	16 D	$\beta\gamma$	G	G	G
Rh-101	3.2 Y	$\beta\gamma$	G	G	G
Rh-102	2.9 Y	$\beta\gamma$	G	G	G
Rh-102m	207 D	$\beta\gamma$	G	G	G
Rh-103m	56.12 M	$\beta\gamma$	G	N	N
Rh-105	35.36 H	$\beta\gamma$	G	G	N
<i>Rubidium</i>					
Rb-81	4.58 H	$\beta\gamma$	G	G	S
Rb-83	86.2 D	$\beta\gamma$	G	G	G
Rb-84	32.77 D	$\beta\gamma$	G	G	G
Rb-86	18.66 D	$\beta\gamma$	G	G	N
Rb-87	4.7E10 Y	$\beta$	G	N	N
<i>Ruthenium</i>					
Ru-97	2.9 D	$\beta\gamma$	G	G	G
Ru-103	39.28D	$\beta\gamma$	G	G	S
Ru-105	4.44 H	$\beta\gamma$	G	G	S
Ru-106	368.2 D	$\beta\gamma$	G	G	N
<i>Samarium</i>					
Sm-145	340 D	$\alpha$	G	G	G
Sm-147	1.06E11 Y	$\beta\gamma$	N	N	N
Sm-151	90 Y	$\beta\gamma$	N	N	N
Sm-153	46.7 H	$\beta\gamma$	G	G	N

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Scandium</i>					
Sc-44	3.927 H	$\beta\gamma$	G	G	S
Sc-46	83.83 D	$\beta\gamma$	G	G	G
Sc-47	3.351 D	$\beta\gamma$	G	G	S
Sc-48	43.7 H	$\beta\gamma$	G	G	S
<i>Selenium</i>					
Se-75	119.8 D	$\beta\gamma$	G	G	G
Se-79	65000 Y	$\beta$	N	N	N
<i>Silicon</i>					
Si-31	157.3 M	$\beta\gamma$	G	N	N
Si-32	450 Y	$\beta$	G	N	N
<i>Silver</i>					
Ag-105	41.0 D	$\beta\gamma$	G	G	G
Ag-108m	127 Y	$\beta\gamma$	G	G	G
Ag-110m	249.9 D	$\beta\gamma$	G	G	G
Ag-111	7.45 D	$\beta\gamma$	G	G	N
<i>Sodium</i>					
Na-22	2.602 Y	$\beta\gamma$	G	G	G
Na-24	15.00 H	$\beta\gamma$	G	G	S
<i>Strontium</i>					
Sr-82	25 D	$\beta\gamma$	G	G	S
Sr-85	64.84 D	$\beta\gamma$	G	G	G
Sr-85m	69.5 M	$\beta\gamma$	G	G	S
Sr-87m	2.805 H	$\beta\gamma$	G	G	S
Sr-89	50.5 D	$\beta\gamma$	G	N	N
Sr-90	29.12 Y	$\beta\gamma$	G	N	N
Sr-91	9.5 H	$\beta\gamma$	G	G	S
Sr-92	2.71 H	$\beta\gamma$	G	G	S
<i>Sulfur</i>					
S-35	87.44 D	$\beta$	N	N	N
<i>Tantalum</i>					
Ta-179	664.9 D	$\beta\gamma$	G	G	G
Ta-182	115.0 D	$\beta\gamma$	G	G	S

**Appendix C: “None/Some/Good” Table**

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Technetium</i>					
Tc-95m	61 D	$\beta\gamma$	G	G	G
Tc-96	4.28D	$\beta\gamma$	G	G	G
Tc-96m	51.5 m	$\beta\gamma$	S	S	N
Tc-97	2.6E6 Y	$\beta\gamma$	G	N	G
Tc-97m	87 D	$\beta\gamma$	G	G	G
Tc-98	4.2E6 Y	$\beta\gamma$	G	G	G
Tc-99	2.13E5 Y	$\beta$	G	N	N
Tc-99m	6.02 H	$\beta\gamma$	G	G	G
<i>Tellurium</i>					
Te-121	17 D	$\beta\gamma$	G	G	G
Te-121m	154 D	$\beta\gamma$	G	G	G
Te-123m	119.7 D	$\beta\gamma$	G	G	G
Te-125m	58 D	$\beta\gamma$	G	G	G
Te-127	9.35 H	$\beta\gamma$	G	S	N
Te-127m	109 D	$\beta\gamma$	G	S	N
Te-129	69.6 M	$\beta\gamma$	G	S	N
Te-129m	33.6 D	$\beta\gamma$	G	G	N
Te-131m	30 H	$\beta\gamma$	G	G	S
Te-132	78.2 H	$\beta\gamma$	G	G	G
<i>Terbium</i>					
Tb-157	150 Y	$\beta\gamma$	G	S	N
Tb-158	150 Y	$\beta\gamma$	G	G	S
Tb-160	72.3 D	$\beta\gamma$	G	G	S
<i>Thallium</i>					
TI-200	26.1 H	$\beta\gamma$	G	G	S
TI-201	3.044 D	$\beta\gamma$	G	G	G
TI-202	12.23 D	$\beta\gamma$	G	G	S
TI-204	3.779 Y	$\beta\gamma$	G	S	N
<i>Thorium</i>					
Th-227	18.718 D	$\alpha\beta\gamma$	G	S	N
Th-228	1.9131 Y	$\alpha\beta\gamma$	G	N	N
Th-229	7340 Y	$\alpha\beta\gamma$	S	N	N
Th-230	7.7E4 Y	$\alpha\beta\gamma$	N	N	N
Th-231	25.52 H	$\alpha\beta\gamma$	G	G	S
Th-232	1.405E10 Y	$\alpha\beta\gamma$	N	N	N
Th-234	24.10 D	$\alpha\beta\gamma$	G	S	N

**Appendix C: “None/Some/Good” Table**

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Thulium</i>					
Tm-167	9.24 D	$\beta\gamma$	G	G	G
Tm-170	128.6 D	$\beta\gamma$	G	S	N
Tm-171	1.92 Y	$\beta\gamma$	G	S	N
<i>Tin</i>					
Sn-113	115.1 D	$\beta\gamma$	G	G	G
Sn-117m	13.61 D	$\beta\gamma$	G	G	S
Sn-119m	293.0 D	$\beta\gamma$	G	G	G
Sn-121	55 Y	$\beta\gamma$	G	N	N
Sn-123	129.2 D	$\beta\gamma$	G	S	N
Sn-125	9.64 D	$\beta\gamma$	G	G	N
Sn-126	1.0E5 Y	$\beta\gamma$	G	G	S
<i>Titanium</i>					
Ti-44	47.3 Y	$\beta\gamma$	G	G	S
<i>Tungsten(Wolfram)</i>					
W-178	21.7 D	$\beta\gamma$	G	G	S
W-181	121.2 D	$\beta\gamma$	G	G	G
W-185	75.1 D	$\beta\gamma$	G	N	N
W-187	23.9 H	$\beta\gamma$	G	G	S
W-188	69.4 D	$\beta\gamma$	G	G	N
<i>Uranium</i>					
U-230	20.8 D	$\alpha\beta\gamma$	N	N	N
U-232	72 Y	$\alpha\beta\gamma$	N	N	N
U-233	1.585E5 Y	$\alpha\beta\gamma$	N	N	N
U-234	2.445E5 Y	$\alpha\beta\gamma$	N	N	N
U-235	703.8E6 Y	$\alpha\beta\gamma$	G	G	S
U-236	2.3415E7 Y	$\alpha\beta\gamma$	N	N	N
U-238	4.468E9 Y	$\alpha\beta\gamma$	G	N	N
U-nat <sup>1</sup>		$\alpha\beta\gamma$	G	N	S
U-nat <sup>2</sup>		$\alpha\beta\gamma$	G	S	N
U-nat <sup>3</sup>		$\alpha\beta\gamma$	S	N	N
<i>Vanadium</i>					
V-48	16.238 D	$\beta\gamma$	G	G	S
V-49	330 D	$\beta\gamma$	N	N	

**Appendix C: “None/Some/Good” Table**

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<b>Nuclide</b>	<b>Half-life</b>	<b>Radiation</b>	<b>700 Shield</b>		<b>715</b>
			<b>Open</b>	<b>Closed</b>	
<i>Xenon</i>					
Xe-122	20.1 H	$\beta\gamma$	G	G	S
Xe-123	2.08 H	$\beta\gamma$	G	G	N
Xe-127	36.41 D	$\beta\gamma$	G	G	G
Xe-131m	11.9 D	$\beta\gamma$	G	G	G
Xe-133	.245 D	$\beta\gamma$	G	G	G
Xe-135	9.09 H	$\beta\gamma$	G	G	G
<i>Ytterbium</i>					
Yb-169	32.01 D	$\beta\gamma$	G	G	G
Yb-175	4.19 D	$\beta\gamma$	G	G	N
<i>Yttrium</i>					
Y-87	80.3 H	$\beta\gamma$	G	G	G
Y-88	106.64 D	$\beta\gamma$	G	G	G
Y-90	64.0 H	$\beta\gamma$	G	N	N
Y-91	58.51 D	$\beta\gamma$	G	S	N
Y-91m	49.71 M	$\beta\gamma$	G	G	S
Y-92	3.54 H	$\beta\gamma$	G	G	S
Y-93	10.1 H	$\beta\gamma$	G	G	N
<i>Zinc</i>					
Zn-65	243.9 D	$\beta\gamma$	G	G	G
Zn-69	57 M	$\beta\gamma$	G	N	N
Zn-69m	13.76 H	$\beta\gamma$	G	G	S
<i>Zirconium</i>					
Zr-88	83.4 D	$\beta\gamma$	G	G	G
Zr-93	1.53E6 Y	$\beta$	N	N	N
Zr-95	63.98 D	$\beta\gamma$	G	G	G
Zr-97	16.90 H	$\beta\gamma$	G	G	S

<sup>1</sup> Computed response for natural Uranium

<sup>2</sup> Observed response for a 1 kg compact pile of yellowcake

<sup>3</sup> Observed response from a 1 kg cube of depleted uranium metal